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A.W. Malm

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5. ICHTHYOLOGICAL REMARKS. - Mr A. W. Malm submitted the following papers under this title. (224)

I. On Mullus dubius, a new species? Table III, figure 1.

Characteristics of the species — The head is elongated, the limits of its upper and lower surfaces, which are identical, converge at the blunt snout. The upper third of the head, as well as the back, are gravish green in colour and the other parts of the body are silver white. - Gill membrane, 3; Dorsal fin, 7 - 1, 8; Pectoral fin, 14; Pelvic fin, 6; Anal fin, 1, 6; Caudal fin, 7, 15, 6.

It is possible that this fish could be a young specimen of the common M. surmuletus L. and it is not without much hesitation that I have dared to declare it a distinct species. Although the shape of the head differs considerably from that of the European Mullini so far identified, I would not have dared to consider this

fish a distinct species, had there been no other important characteristic to distinguish it. We know how much the head changes in fishes, but it still appears probable that when Mull. surmuletus has reached this size, its head should have more or less obtained its adult shape. The most important feature that separates the specimen that will be described here from M. surmuletus is that it has, not only in the lower jaw, but also in the upper jaw, small, pointed teeth that can be seen only through a magnifying glass, just like the tropical Mullini, subgenus Upeneus CUV. et Val., 1829, Hypeneus AGASS. Is it possible, that our European Mullini also as young have (225) teeth in the upper jaw? If so, then the described fish is only a young specimen of M. surmuletus, and Mullus and Hypeneus will then be so much more closely related. - On the vomer, the teeth are also small and pointed and form two ovals, somewhat connected at the front. - The gill membrane, carefully examined under a microscope, has no more than three rays. - The scales are large, thin and fall off so easily that only a few remained on this specimen, just behind the pectoral fins. On the head, which had probably also been covered by scales, there is not a trace of scales; therefore, I did not wish to mark any scales in my figure on this part. The shape of the scales has been accurately recorded in the figure, with the aid of Dr. F. v. Hagenow's excellent "dichatopts"*. From the front edge (the attached edge), which is vertical, several (5) coiled vessels, filled with a whitish yellow nutritive liquid, enter into one scale on the lateral line, and somewhat fewer (3) into another scale just below. The front

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* Transl. note: Sw. "dikatopter" - Careful research provided no clue to the meaning of this word.

(Most probably, "dicatoptrics". Revisor's note)

edge of the latter is rounded and shallowly eroded (erosus), whereby 20 short but pointed teeth have been formed. The attached part of the scale has several vertically coiled ridges placed very closely together, but on the rest of the scale these ridges are vertically rectilinear. On the scale I have now described, I counted 162 such ridges. The scale from the lateral line, which resembles the former in shape but has a cut-off posterior edge, is also eroded. The teeth, which number 46, are longer and sharper than on the previous scale, a few are even spiny. At the centre of the height of the scale and on the first fourth of its length are two spines that are turned forward and somewhat upwards and reach across the centre of the scale. The back edge of the scale is slit open, and this slit is connected to the posterior one of the three mucus-producing vessel apertures located at the base of the just mentioned spines. The vertical ridges on the back part of the scale are not as symmetrical as on the previous scale, and at the centre of the scale they are turned somewhat backwards. - The total length of the fish is 53 mm.

The above described specimen was caught on August 15, 1852, (226) at the pier at Christineberg, close to Fiskebäckskil, in a so-called "seine".

II. On the fry of Caranx trachurus.*

During my stay in the Bohuslän Archipelago last summer,

* Transl. note: I have translated this as "horse mackerel". The Swedish common name means "thorny mackerel".

an old fisherman told me that the whiting (Merlangus vulgaris)is "formed" in the jellyfish (Cyanea capillata); another assured me that the jellyfish gives birth to the herring fry.

In order to find the reason for these remarks, I caught and examined many jellyfish and found in one 7, in another 3, and in a third, 5 small fry of Caranx trachurus. They were all found among the ovaries of the Cyanea and when I tried to catch these small fish, they worked themselves up under the disc of the jellyfish as far as they could. With the last that I obtained I made the following experiments. After I had put the fish in a vessel filled with water, I returned the jellyfish to freedom, and when I shortly thereafter released the fish one after the other, I saw, to my great delight, how they all dove after the jellyfish, which had lowered itself to a depth of about 2 feet, and they instantly escaped under its disc. This operation was repeated, but 4 of my fish died in the attempt, so that only one reached its, as it appears, beloved jellyfish. Finally, I took the jellyfish and put it in a boat that was lying on the shore partly submerged, and during the three following days when I was staying at Christineberg, I often visited this jellyfish, among whose ovaries the little fish was slowly moving about. After I had examined the intestinal canal of the fish and found it filled with the eggs of the jellyfish, I have no doubt that these fry live in the Cyanea capillata as a kind of parasite. As a further reason for this, perhaps daring assumption, I wish to add that although I carried out careful searches, I was unable to discover this type of fish fry except in the mentioned jellyfish. It also deserves to

be mentioned that I have found no other fish species living in the mentioned Cyanea, although she sometimes swam among thousands of (227)
individuals of Gobius Ruthensparri EUPHRAS and other small fish species. That the horse mackerel already when it is very young enters into the ovaries of the jellyfish to feed and remains there until the fish is more fully developed may finally also be assumed from the fact that the individuals found in the same jellyfish were nearly all of the same size. In the comparative table below, those entered under numbers 1 and 2 were found in one jellyfish; numbers 3 and 4 were found in the second jellyfish and the third jellyfish, which was much smaller than the other two, had in it the largest of the fish or those that were entered under number 5. The 7 fry that were found together were the smallest, were next the 5, and the 3 were the largest.

That these fish, which I at first thought belonged to the genus of Seriola CUV. et VALENC, are the young of the horse mackerel (Caranx trachurus), is apparent from the following description of the specimens that had just died.

Measurements of specimen no.	1.	2.	3.	4.	5.	6.
Total length	12 1/3	14 ½	21 1/4	29	35½	70½ mm
Maximum height	3 1/5	3 4/5	5 5/6	7	8¼	14¼ mm
Length of head	3	3 3/4	6	8 1/6	9 2/3	17 mm
From tip of snout to front edge of eye	1 1/5	1 3/5	2	2 3/4	3 1/3	6½ "

The number of fin rays in specimen no.4: dorsal fin 8; 1, 30; pectoral fin 21; pelvic fin 1, 5; anal fin 3, 26; caudal fin 10, 13, 9.

The above measurements show that the larger the fish, the more elongated the head becomes and particularly the snout. The mouth slit, instead of as in number 1 being rather much turned upwards, assumes at a more mature age a position that approaches the horizontal. Thus, it rises from a line drawn parallel to the median of the body in no. 1, 53°, in no. 2, 41°, in no. 3, 34°, in no. 4, 32°, in no. 5, 31°, and in no. 6 only 27°.

Hereby we find that the mouth slit is lowered the most during the period of growth that occurs between sizes 1 and 2, and that its further lowering continues less noticeably, although the individual soon grows quite considerably. I have no specimen smaller (228) than no. 1, but I assume that the mouth slit in still smaller fry must be even more turned upward and forward.

Numbers 1 - 5 are all specimens found in jellyfish, but no. 6 is an individual that I found here in Gothenburg this past autumn (1851) among Clupea sprattus and fry of Cl. harengus.

Another remarkable feature of the development of this species is found in the laminae of the lateral line, of which there is not the slightest trace in no. 1. In numbers 2 and 3 there is only a

suggestion of them in the form of unnoticeable impressions along the lateral line, and in all these three the side of the tail base shows no trace of the prominent edge which, in a more mature stage, is so characteristic of this species. In no. 4 this ridge appears clearly and somewhat distinct and laminae can also be detected, although they are so undeveloped and barely indicated, that one can only see them through a magnifying glass; but in no. 5 they are so developed, that one can see this beautiful feature with the naked eye. The lateral ridge of the tail base is sharp and the plate line appears clearly if one lets the fish dry a little. This plate line is, however, still quite noticeable towards the area of the operculum, but in no. 6 the laminae are also here well developed and from this stage on, or even in no. 5, Caranx is unmistakable.

The colour of the living specimens was silvery white. The back, neck, an arc on the upper part of the eye ring, as well as the edges of the dorsal fins were blackish. The posterior part of the lateral line, as well as the other parts of the body, except the underside, had primary pigmentation spots placed in lines and surrounded by a large collection of extremely small secondary spots. It is these latter that at a more mature age spread out so much that the surface of the fish, already in no. 5, appears covered with fine, blackish dots.

III. On Lampris guttatus RETZ (229)

An average-sized individual of this large and beautiful fish species, which actually belongs to the northern part of the Atlantic Ocean where it borders on Europe and extremely seldom visits our coasts, was caught on the 9th of July, 1852, between Lindesnäs and Skagen, during so-called "spiller fishing". The fishermen, who had their homes on Käringön in the Bohuslän Archipelago, saw at once that they had caught something unusual. They therefore removed the skin of the fish and brought it, after a week, to me in such a poor condition that it was only with difficulty that I was able to make the following short description. The skin itself was torn apart in several places, but the head and the fins, which are now kept in the Zoological Museum of Gothenburg, were in quite good condition.

The dorsal fin, which had a maximum height of 190 mm, has 55 rays of which the first 13 form the anterior, sickle-shaped part. The pectoral fin, which is 250 mm high and 70 mm long at the base, has 24 rays. The pelvic fin has 15, the anal fin 39 and the caudal fin 6, 19, 5 rays. Each of the lobes of the caudal fin has a length of 220 mm; its centre measures only 70 mm, so that it is very indented. Six rays remain in the gill membrane. The anterior or seventh had been cut off.

I cannot with complete accuracy determine the total length of the specimen, but it appears to have been about 880 mm. The length of the head from the tip of the snout to the posterior edge of the gill-cover is 255 mm. The colour of the back appears to have been purple, and the sides of the body had a beautiful silvery shine, with lighter spots. The person who brought me the fish said that the fins had a lively red colour when the fish was alive, a colour which, together with that of the body, gave this fish an unusual and brilliant appearance.

Any further description of this rather well-known fish species should not be necessary, especially of this disfigured specimen. In relating this I simply wished to report its existence in the Kattegat, as well as the principal measurements that show (230) the size of the specimen.

IV. Notes on the development of the Garfish. Table III, figure 2.

On page 107 of the Publications of the Royal Scientific Society of Gothenburg of 1851, I briefly mentioned Belone vulgaris when it is in a stage of development that resembles the tropical genus Hemiramphus. This stage of the garfish has been found quite frequently and has been the object of investigations and even disputes. COUCH found such small fish in July of 1818; in 1837, Edward CLARKE

sent such specimens to YARRELL, who described then in a supplement to "British fishes" under the name of Hem. europaeus, although with some hesitation since they could be the young of Belone. In the second edition of the above-mentioned publication, Yarrell considers his H. eur. as definitely different from Belone, which is particularly clear from what is said on page 452: "The question hazarded in the Supplement, - Is this fish, with its unequally developed jaws, the very young state of our common Garfish (Belone vulgaris) - is now answered, that it is not: Mr GEORGE CLARKE having found the fry of the Garfish so small as only to measure one inch, with both the jaws of equal length."

On June 9th, 1842 Prof. BEHN found such fry in the Kiel Firth. VAN D. HOEVEN has written about them and considered them to belong to the genus of Hemiramphus; but Behn himself considered them to belong to Belone, which he also tried to prove in a letter to V. d. Hoeven. It was at this time that Professor HORNSCHUCH appeared and pointed to differences between Yarrel's Hemiramphus and that of V. d. Hoeven, and also suggested for the latter the name of balthicus, a name that V. d. Hoeven considered less suitable and wished to change to H. Behnii.

In general, however, very little attention has been paid to the fact that, to my knowledge, nobody has so far been in possession of such a complete set of these fry as to enable a more satisfactory solution of this matter. During the past summer I succeeded in (231)

observing Belone's development and I here present the results of my investigations.

Towards the end of May, or during the first half of June, the garfish comes close to our shores to spawn. For this she selects a shallow bay, whose bottom has a rich growth of Zostera marina.

On June 22nd, 1852, I found at Utterbäck the fry reproduced in figures a, b, and c; on July 22nd the ones shown in figure d; on August 11th those in figure e and on the 17th of the same month those shown in figure f: the three latter stages at Christineberg. The small ones (a, b, and c) appeared in dense shoals at the very surface of the water, with 1-3 feet deep water, particularly around Fucaceæ and fed on the there abundant Entomostraca, as well as on Laomedea gelatinosa. Their movements were lively and when I tried to catch them, they usually saved themselves by instantly heading for the bottom; but as soon as everything around them was quiet again, they returned to the surface. Their colour in the water appeared, according to their age, as white-yellow, yellow-green or green-blue, lancet-like streaks. When the garfish has reached size d, she swims in less dense shoals, so that one only encounters about 20 together. Perhaps the greater part of the original shoal has become prey to other predators*. It then lives

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* I wish to mention the following from my experiences in this matter: On June 22nd I caught, on a Fuc. vesiculosus, a Carcinus maenas, whose cephalothorax measured 10 mm in diametre. In its right pincer it held a garfish of size a, partly eaten. I threw the crab in a glass and saw how she with relish devoured the rest of the fish.

particularly among the fry of Gobius Ruthensparri and gets its main nourishment from this species. When the garfish has reached size f, she will also hunt older Gobius individuals. Gob. niger and minutus are left alone by her, because they follow the bottom, whereas G. Ruth. always swims higher up, close to the surface and in this way its way of life differs considerably from its mentioned relatives. When the garfish is of the size just mentioned, she (232) usually swims alone or a few together, proceeds slowly just under the surface of the water towards the Gobii shoals; but when she has selected her prey, she dashes diagonally into the shoals and seldom misses her goal.

Measurements & numbers of fin rays of the specimens

	a.	b.	c.	d.	e.	f.	Max. in a full-grown fish
Total length	13	14	18½	49	64	150	mm
Length of head	2½	$2\frac{3}{4}$	$5\frac{1}{5}$	$17\frac{1}{3}$	22	54	
Rays of dorsal fin	9	12	15	16	17	17	19
" " pectoral fin	7	9	10	11	11	12	13
" " pelvic fin	s*	s.	s.	sp.**	7	7	7
" " anal fin	18	18	19	19	20	20	22
" " caudal fin	14	14	15	16	18	7,15,6	6,19,5

The head of a: from the area above the back edge of the eye down to the broad tip of the lower jaw, the profile of the head exhibits such an even curvature that if one makes the lower edge of the head, directly below the back edge of the eye, the centre of

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* s. means that the fin is completely absent.
** sp. " " there are traces of the fin, suggested by a wart-like swelling, with a membrane containing indistinct rays.

a circle, then the rounding of the head coincides exactly with the periphery of this circle. The front edge of max. inf. also fits exactly with the periphery, but ossa intermax. inf., which are surrounded by easily detachable skin, extend like two extremely fine tips somewhat ahead of this periphery. The upper jaw, seen from above, is both here and in b broad and rounded; but in b the centre of the periphery of the mentioned profile lies as far below the head as 2/3, and as far behind the back edge of the eye as 2/5 of the diametre of the eye. Max. inf. extends so far in front of the upper jaw as the diametre of the pupil; the intermaxillary bones the same. In c, the upper contour of the head, from the front edge of the eye to the somewhat pointed tip of the upper jaw, is an almost straight line, which forms an angle of 148° to a second (233) line drawn across and parallel to the median of the body. The far protruding intermaxillary bones are now of the same length as the height of the head at the front edge of the eye. The swelling of the neck which is so obvious in a and b has now shrunk considerably in c. In d the above-mentioned angle is even larger, or 162°. The upper jaw, seen from above, protrudes in a rather long tip. Although it is quite wide, its forward sides have clearly turned-in edges. E, and particularly f, provide quite a recognizable picture of the garfish, but the upper jaw, also in f, has not yet reached the length in relation to the lower jaw, that it has in a full-grown individual. The intermaxillary bones are still in their entire length held together only by the cellular tissue which lies between them and by the easily detachable skin that surrounds them. From

a to f the back edge of the gill-cover becomes more and more oblique. A has the original skin fin in front of the anus, and also between the dorsal and caudal fins, and between the anal and caudal fins. In b and c this membrane is becoming less and less visible. It is entirely absent in d, the pelvic fins begin to appear and the caudal fin, which is rounded in a with the upper edge being the longest, the same in b, in c evenly rounded, in d as though bluntly cut off, in e somewhat indented, is in f very indented.

The colour of this fry is mentioned both above, and also described by me in the quoted passages. I only wish to add that the colour of the eye, also in a, is not particularly different from that of the full-grown fish. The case of the pigmentation spots in this species (as is probably the case with all spotted fish species) is the same as for the primary, secondary, etc. bumps in Echinus esculentus, namely that they in the very young are placed in symmetrical rows, and each primary spot is surrounded by a large number of secondary spots; these latter gradually become so enlarged that one can hardly follow and separate them from each other in a full-grown individual.

It is clear from the above, that the garfish does not reach such a state of development that it can be recognized with certainty until size e. She would then be at least 8 -10 weeks old. (234)

Conclusions: c is Hem. balthicus HORNSCH; d is H. europaeus YARRELL; a and b have, to my knowledge, not been previously described, but all are the young of the well-known Belone vulgaris.

Explanations to figures:

1: Mullus dubius in actual size.

a: marks the place where the enlarged scales were located.

1b: scales from the lateral line.

1c: a scale just below the lateral line.

2a-2e: enlarged heads of fry of Belone vulgaris.

2f: fry in actual size.

The lines placed in the figures denote: at 1b and 1c the actual height of the scale; at 2a-2e the length of the head from the tip of the lower jaw to the upper edge of the gill-cover.